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Recovery of Synthetic Resins

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This invention is for improvements in or relating to the recovery of synthetic resins and has for an object to provide a convenient process for the recovery of synthetic resins, such as polyvinyl chloride, from resin-coated metals, such as insulated wires.

The invention is based on the observation that a synthetic resin, particularly a plasticised polyvinyl chloride or polyethylene, when dissolved in a low-boiling solvent and injected into hot water, is precipitated in substantially pure solvent-free condition as a result of the removal of the solvent, either by evaporation or by steam-distillation.

According to the present invention, therefore, there is provided a process for the recovery of synthetic resins from plastic-coated metal which comprises treating the coated metal with a solvent for the synthetic resin to strip the resin from the metal and to form a solution thereof, thereafter contacting said resin solution with water maintained at a temperature which is sufficient to volatilise the solvent and to precipitate the dissolved synthetic resin.

It is preferred to employ solvents whose boiling point is below the boiling point of water and the invention, therefore, includes the use of solvents whose boiling point is below 100°C. which are injected into water maintained at or about its boiling point.

An alternative and convenient way of carrying the invention into effect is by the introduction of steam into the resin solution to effect steam distillation of the solvent therefrom.

A further feature of the invention consists in that the plastic-coated metal is first soaked in a softening agent for the plastic to soften it whereupon the softened plastic material is partly recovered by mechanically removing it from the metal by expression in a press or by centrifugal action, the partially stripped metal being thereafter treated with solvent to dissolve residual plastic therefrom, the plastic material being stripped of solvent, in each case, by treatment with water at a temperature sufficient to volatilise the solvent.

In the case of electric wires and cables covered with plasticised polyvinyl chloride, the wires or cables are baled, soaked in methyl ethyl ketone and the softened plastic extruded by placing the treated bale in a press and applying pressure thereto, the softened plastic being preferably extruded through a perforated plate or through metal gauze whereby the extruded plastic is filtered free from impurities and is in the form of elongated thin rods. The extruded plastic is then treated with boiling water whereby the methyl ethyl ketone is removed in the form of its azeotrope with water.

The choice of the solvent naturally depends upon the nature of the synthetic resin and, in the case of polyvinyl chloride, a preferred solvent is tetrahydrofuran, alternative useful solvents being methyl-isobutyl ketone, mesityl oxide, cyclohexanone and

isophorone, whilst for polyethylene, it has been found that whilst carbon tetrachloride is the preferred solvent, trichloroethylene, toluene and xylene are also eminently suitable.

The recovered solvent, which may be in the form of an azeotrope, may be re-used in the process even though it may contain a certain amount of water.

The following Examples illustrate the manner in which the invention may be carried into effect:-

Example 1:

Short lengths of wire insulated with plasticised polyvinyl chloride, the lengths being approximately 2½ inches long and having a coating of polyvinyl chloride of from 0.02 to 0.04 inches, were covered with tetrahydrofuran in an amount of 100 ccs. to each 50 grams of the pieces of insulated wire. Heat was then applied and the tetrahydrofuran was refluxed for 20 minutes during which time substantially the whole of the polyvinyl chloride coating on the insulated wire was taken up into solution.

The solution of polyvinyl chloride was then dropped at the rate of about 1 drop per second into boiling water, whereupon the polyvinyl chloride still containing the plasticiser was precipitated in the form of spongey flakes which coalesced at the bottom of the vessel, the tetrahydrofuran distilling over and being collected in the form of an azeotrope which contained 5.3% of water and boils at 64°C. Starting with the initial 100 ccs. of tetrahydrofuran there were recovered 85 ccs. of the azeotrope and the azeotrope can be recycled as it is still a powerful solvent for polyvinyl chloride. The amount of solvent employed when utilising the technique of this Example is preferably maintained at at least 100 ccs. for each 35 grams of polyvinyl chloride.

Example 2:

53 grams of 2½-inch lengths of insulated wire, as used in Example 1, were treated as described in the preceding Example for the substantially complete stripping of the polyvinyl chloride from the wire.

Instead of proceeding by introducing the solution into boiling water, as described in Example 1, the solution was separated from the stripped wires and steam was blown through the solution, effecting a steam distillation of the tetrahydrofuran. As the steam distillation proceeded, the polyvinyl chloride was precipitated from its solution in the form of a coarse sponge. When utilising the steam distillation technique of Example 2, it is possible to employ a lesser quantity of solvent than is required when following the technique of Example 1.

The procedure of the two foregoing Examples can be followed without substantial modification in the application of carbon tetrachloride to the recovery of polyethylene from lengths of wire insulated with polyethylene.

The following further Examples illustrate the carrying out of the invention on a larger scale.

Example 3:

A compressed bale of copper wire covered with plasticised polyvinyl chloride weighing 13¾ lbs. was refluxed with 4 gallons of tetrahydrofuran for 5 hours to obtain complete solution of the polyvinyl chloride. The hot solution was filtered and pumped through a jet to form a spray into 4 gallons of boiling water over a period of approximately one hour. The tetrahydrofuran azeotrope, b.p. 64°C., distilled over at

the rate of approximately 4 gallons per hour. At the completion of the distillation the water was run off and the following quantities of products recovered:

Clean copper wire	7¾ lbs.
Partially foamed plasticised polyvinyl chloride	5½ lbs.
Tetrahydrofuran azeotrope	3.94 gallons

Example 4:

In this Example, a bale of copper wire covered with plasticised polyvinyl chloride, weight 12 lbs. 15 ozs., was soaked in 3 gallons of methyl ethyl ketone for 3 hours. At the end of this time the plastic coating had softened and the bulk was removed by expressing under pressure through a plate perforated with 1/16" holes. The bale of almost clean wire was then submitted to the tetrahydrofuran process as in Example 3 for 2 hours, using 4 gallons of solvent. The polyvinyl chloride methyl ethyl ketone mixture was placed in a distillation kettle with 4 gallons of water and the whole mixture boiled for 1½ hours at the end of which time the distillation of the azeotrope was complete. The following quantities of products were recovered:

Clean copper wire	6 lbs. 10 ozs.
Partially granulated plasticised polyvinyl chloride	6 lbs. 5 ozs.
Tetrahydrofuran azeotrope	3.9 gallons
Methyl ethyl ketone azeotrope	3.29 gallons

Example 5:

A bale of polythene-covered copper wire, weight 11¾ lbs., was refluxed with 4 gallons of carbon tetrachloride for 4 hours at the end of which time solution was complete. The solution whilst still hot was filtered and sprayed into 4 gallons of boiling water and the distillate of carbon tetrachloride collected. The polythene was precipitated as a clean coarse foam. The distillation was complete in 1½ hours and the following quantities of products collected:

Copper wire	8 lbs.
Polythene	3½ lbs.
Carbon-tetrachloride	3.9 gallons.

Example 6:

A bale of covered wire insulated with polyethylene and sheathed with a coating of plasticised polyvinyl chloride weighing 9 lbs. 5 ozs. was treated with 4 gallons of tetrahydrofuran for 5 hours. At the end of this time the solution, whilst still warm, was filtered and sprayed under pressure into 4 gallons of boiling water as a result of which the polyvinyl chloride was precipitated and the tetrahydrofuran distilled over as the azeotrope. The bale, now consisting of polyethylene covered wire, was further refluxed for 4 hours with 4 gallons of carbon tetrachloride to dissolve the polyethylene. The solution was then filtered hot and sprayed under pressure into 4 gallons of boiling water and the carbon tetrachloride distilled over as described in Example 5. The quantities of products resulting from the process being -

Copper wire	3 lbs. 3½ ozs.
Polyvinyl chloride	5 lbs. ½ oz.
Polyethylene	1 lb. 1 oz.
Carbon tetrachloride	3.9 gallons
Tetrahydrofuran azeotrope	4.1 gallons

It will be appreciated that mixed scrap wire and cable in which polyethylene and polyvinyl chloride form the insulation may be treated without sorting by the use of selective solvents as described in Example 6; thus the mixed scrap is first treated with tetrahydrofuran, or other solvent which dissolves polyvinyl chloride but not polyethylene, to dissolve out the polyvinyl chloride whereafter the polyethylene in the treated mixed scrap is then treated with carbon tetrachloride or other solvent for polyethylene; the two solutions of the individual plastics are then treated as above described to precipitate the plastic materials and free them from solvent.

The general methods of plastic recovery as shown in the foregoing examples indicate how certain plastics can be separated from an insoluble material like metal wire. It will be readily appreciated that the process can equally well be applied to the recovery of plastic materials such as poly-vinyl-chloride and poly-ethylene either without metal present or with other insoluble materials instead of or in addition to metals, as for example, fabric, paper and wool.

The plant required for carrying out the process of the invention is very simple and requires only a vessel in which the dissolving treatment is carried out and a vessel in which the solvent is stripped off. The dissolving vessel requires heating means for heating the solvent, a reflux condenser and inlet and outlet connections for the feeding of solvent and removal of solution. The outlet connection is connected by a pump to a spray jet extending into the solvent stripping vessel which is provided with a solvent recovery system, with heating means for heating the water into which the solution is sprayed and with an outlet connection through which the precipitated plastic material is withdrawn in suspension in the water.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A process for the recovery of synthetic resins from plastic-coated metal which comprises treating the coated metal with a solvent for the synthetic resin to strip the resin from the metal and to form a solution thereof, thereafter contacting said resin solution with water maintained at a temperature which is sufficient to volatilise the solvent and to precipitate the dissolved synthetic resin.

2. A process according to claim 1 wherein the solvent has a boiling point below 100° C. and the water is maintained at its boiling point.

3. A process according to claim 2 wherein the solution of the resin is sprayed into a body of boiling water.

4. A process according to claim 1 wherein the solvent is volatilised by steam distillation by the injection of steam into the solution.

5. A process according to claim 1 wherein the plastic-coated metal is first soaked in a softening agent for the plastic to soften it, whereupon the softened plastic material is partly recovered by mechanically removing it from the metal prior to dissolving the resin.

6. A process according to claim 5 wherein the softened plastic material is removed from the metal by expression in a press.

7. A process according to claim 1 wherein the resin is a plasticised polyvinyl chloride and the solvent is tetrahydrofuran.

8. A process according to claim 1 wherein the resin is polyethylene and the solvent is carbon tetrachloride.

9. A process according to claim 1 wherein the resin-coated metal is an insulated wire in which the insulation is polyethylene covered with a sheath of plasticised polyvinyl chloride, the wire being first treated with tetrahydrofuran to dissolve the polyvinyl chloride and thereafter treated with carbon tetrachloride to strip the wire of the polyethylene, the two

solutions being separately stripped of their solvent contents to provide separate rec very of the polyethyl n and the polyvinyl chloride.

10. A process for th recovery of synthetic resins which comprises treating scrap synthetic resin with a solvent to form a solution thereof, thereafter contacting said resin solution with water maintained at a temperature which is sufficient to volatilise the s lvent and to precipitate the dissolved synthetic r sin.

11. A process for the recovery of both wire and insulating material from scrap electrical conductors sheathed with plasticised synthetic resin insulating material which comprises dissolving the said insulating material from the wire f the electrical conductor by treatment with a solvent therefor, separating the cleaned wire from the solution f insulating material thereby produced and recovering the synthetic resin together with the plasticiser from the said solution by volatilisation of the solvent by the action of hot water and recovering the volatilised solvent and the precipitated plasticised synthetic resin.

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